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ABSTRACT

In the first of these two lessons, students study the concepts of three sides of equal length, three equal angles, plane figure, closed figure, and simple figure by reading descriptions, considering examples and nonexamples, and completing exercises. On the second day they combine these concepts in a definition of equilateral triangle. The materials are self-contained but should be preceded by introduction or review of a vocabulary list provided; answers and explanations immediately follow each set of exercises. A brief introductory review of research related to concept learning describes the rationale for the techniques used within the lessons which were developed as part of the Project on Conditions of School Learning and Instructional Strategies at the University of Wisconsin. (SD)

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Practical Paper No. 14

LESSONS DESIGNED TO TEACH FOURTH GRADE STUDENTS THE CONCEPT EQUILATERAL TRIANGLE AT THE FORMAL LEVEL OF ATTAINMENT

by

Nancy E. McMurray, Michael E. Bernard, & Herbert J. Klausmeier

Report from the Project on
Conditions of School Learning and
Instructional Strategies

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Madison, Wisconsin

September, 1974

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STATEMENT OF FOCUS

Individually Guided Education (IGE) is a new comprehensive system of elementary education. The following components of the IGE system are in varying stages of development and implementation: a new organization for instruction and related administrative arrangements; a model of instructional programing for the individual student; and curriculum components in prereading, reading, mathematics, motivation, and environmental education. The development of other curriculum components, of a system for managing instruction by computer, and of instructional strategies is needed to complete the system. Continuing programmatic research is required to provide a sound knowledge base for the components under development and for improved second generation components. Finally, systematic implementation is essential so that the products will function properly in the IGE schools.

The Center plans and carries out the research, development, and implementation components of its IGE program in this sequence: (1) identify the needs and delimit the component problem area; (2) assess the possible constraints--financial resources and availability of staff; (3) formulate general plans and specific procedures for solving the problems; (4) secure and allocate human and material resources to carry out the plans; (5) provide for effective communication among personnel and efficient management of activities and resources; and (6) evaluate the effectiveness of each activity and its contribution to the total program and correct any difficulties through feedback mechanisms and appropriate management techniques.

A self-renewing system of elementary education is projected in each participating elementary school, i.e., one which is less dependent on external sources for direction and is more responsive to the needs of the children attending each particular school. In the IGE schools, Center-developed and other curriculum products compatible with the Center's instructional programing model will lead to higher morale and job satisfaction among educational personnel. Each developmental product makes its unique contribution to IGE as it is implemented in the schools. The various research components add to the knowledge of Center practitioners, developers, and theorists.

INTRODUCTION

Several instructional strategies have been identified as being facilitative of concept learning: a) use of definition (Anderson & Kulhavy, 1972; Feldman & Klausmeier, 1974), b) empirical selection of concept examples through an instance probability analysis (Woolley & Tennyson, 1972), c) use of rational sets of examples and nonexamples (Markle & Tiemann, 1969; Feldman, 1972; Swanson, 1972), d) pairing of examples with nonexamples (Tennyson, Woolley & Merrill, 1972; McMurray, 1974; Houtz, Moore & Davis, 1973), e) emphasis of relevant attributes (Rasmussen & Archer, 1961), f) teaching of a strategy (Bourne, 1966), g) feedback (Clark, 1971), and h) active involvement by the student (Piaget, 1964).

These written, instructional lessons incorporating the above strategies were developed for a study to determine whether fourth grade students could attain the concept equilateral triangle at a higher level than it is normally attained at that grade (McMurray, Bernard & Klausmeier, 1974). For the purposes of that study, instruction was apportioned into two main parts, teaching the attributes of equilateral triangle, and teaching a strategy by which to evaluate previously unencountered examples and nonexamples of the concept.

Lesson 1E taught subjects to discriminate and name the relevant attributes of equilateral triangle through the use of defined and illustrated examples and nonexamples of each attribute active student involvement in drawing each attribute, and exercises in identifying the attributes, after which immediate feedback and rationale were provided to the student.

Lesson 2E taught subjects to evaluate examples and nonexamples of equilateral triangle based on the relevant attributes (taught in lesson

1E) presented in a definition. This lesson incorporated review of previously taught material, presentation of the concept definition, active student involvement in drawing instances of the concept, presentation of rational sets of paired examples and nonexamples including labels and rationales, and the teaching of a strategy to associate the five defining attributes of the concept in a conjunctive fashion, utilizing exercises and feedback in evaluating examples and nonexamples of equilateral triangle.

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Directions for Administering Lesson 1E

Good morning (afternoon). I am going to pass out today's lessons now. Some of you will also receive a ruler to help you make some drawings. When you get your booklet, put your name and the name of your school on it. Where it says teachers name, put only your room number. Leave the rest blank. (Pass out the lesson booklets). I am passing out more than one kind of lesson. It may be that you are reading a different kind of lesson from everyone else. But don't worry about it because this is the way it's supposed to be. Please do not open your booklets until I tell you.

You are going to read this lesson to yourself. While you are reading, there may be some words that you cannot read. If you raise your hand, I will come by and tell you what the words are. Before you raise your hand, try very hard to read the word yourself. Also, if you come to a part where you don't know what you are supposed to do, raise your hand and I will come by.

Now turn to the page where it says WORD LIST. These are some of the words which you may find in your lessons. Because some of them may be new to you, let's take a minute to go over them. The first word is ____. Let's say it together _____. Good. The next word is _____. (Continue until all of the words have been pronounced)

From now on, there can be no talking to each other or out loud. If you want to ask a question raise your hand. Wait until I come by and then quietly ask your question. Do not disturb your classmates. You may have 35 minutes for this lesson.

Are there any questions before we begin?

No talking please.

Now turn to page 1 and begin your lesson.

LESSON I E

Name _____

Today's Date _____

Teacher's Name _____

School's Name _____

Grade _____

Boy Girl

Word List

1. equilateral
2. triangle
3. definition
4. attributes
5. angle
6. length
7. equal
8. plane
9. closed
10. simple
11. straight
12. figure
13. connect

In this lesson you will learn about a special kind of figure. It is called an equilateral triangle. These figures are equilateral triangles.

You will learn five important things about equilateral triangles:

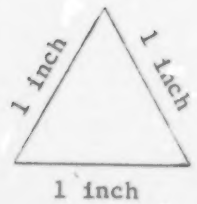
Equilateral triangles have:
They are:

1. three straight sides of equal length
2. three equal angles
3. plane
4. closed
5. simple

You will learn about these five things by looking at some figures. You will draw some figures that are outlined in dots. You will also draw some figures by following the numbered dots. You will need to learn and REMEMBER the names of the five important things about equilateral triangles.

Turn the page.

Let's begin by learning about figures with <u>three straight sides of equal length</u>. Equal means the same.



Look at this figure. It has three straight sides of equal length. Each side is one inch long.

Connect the dots below with your pencil.

This figure has three straight sides of equal length.

Turn the page.

Here are some more figures with three straight sides of equal length.

Now look at the figures below. They do not have three straight sides of equal length.

Connect these dots.

This figure does not have three straight sides of equal length.

Turn the page.

Look at the figures below. Circle the word "yes" if a figure has three straight sides of equal length. Circle the word "no" if a figure does not have three straight sides of equal length.

1.

yes no

2.

yes no

3.

yes no

4.

yes no

Turn the page to see if you are right.

Here are the answers.

1.

(yes) no

Yes, because this figure has three straight sides of equal length.

2.

yes (no)

No, because this figure has only <u>two</u> straight sides of equal length.

3.

yes (no)

No, because this figure has one side that is not straight.

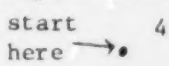
4.

(yes) no

Yes, because this figure has three straight sides of equal length.

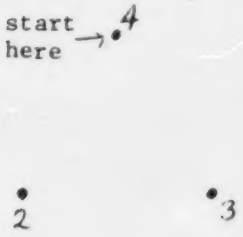
Turn the page

Follow the dots. Does the figure have three straight sides of equal length?



Yes. It does have three straight sides of equal length.

Now follow these dots. Which figure has three straight sides of equal length?



This figure has three straight sides of equal length.

This figure does not.

Write "sides" in the blank below.

three

straight _____

of equal length

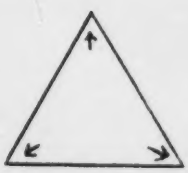
You have now learned one important thing about equilateral triangles. They have three straight sides of equal length. Say it to yourself.

Turn the page.

Now you are going to learn about angles. Look at the drawings below. They show four angles of different sizes.

Connect the dots below to form angles.

Now look at figure 1. It has three angles.
The arrows are pointing to them.



1

Look at Figure 2. It has only 2 angles.
The arrows are pointing to them.

2

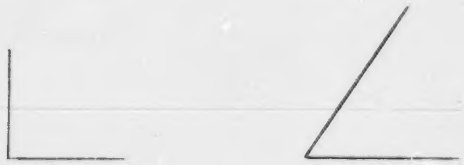
The corners on Figure 3 are not angles.
Figure 3 has no angles.

3

Turn the page

Look at these angles. They are the same size. They are equal angles.

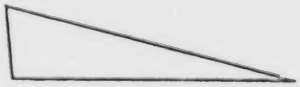
The angles below are not the same size. They are not equal angles.



Look at figure 1. It has three equal angles.

1

Figure 2 does not have three equal angles..



2

Connect these dots.

This figure has three equal angles.

Turn the page.

Look at the figures below. Circle the word "yes" if a figure has three equal angles. Circle the word "no" if a figure does not have three equal angles.

1.

yes no

2.

yes no

3.

yes no

4.

yes no

Turn the page to see if you are right.

Here are the answers.

1.

yes (no)

No, because each angle is a different size.

2.

yes (no)

No, because this figure has only two angles. The round corner is not an angle.

3.

(yes) no

Yes, because this figure has three straight sides of equal length

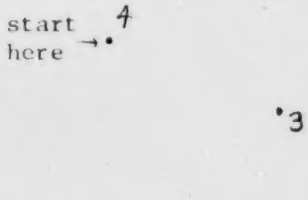
4.

yes (no)

No, because this figure has only two equal angles.

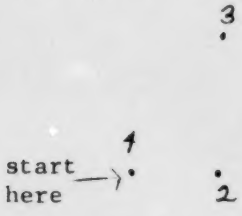
Turn the page.

Follow the dots. Does the figure have three equal angles?

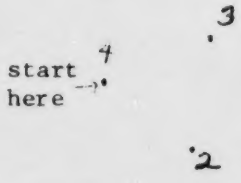


yes. This figure does have three equal angles.

Now follow these dots. Which figure has three equal angles?



This one does not have three equal angles.



This one has three equal angles.

Write "angles" in the blank below.

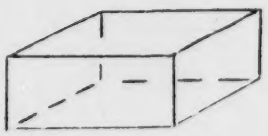
three straight sides of equal length + three equal _____

You have now learned two important things about equilateral triangles. Say them to yourself.

Turn the page.

Figures that are flat are called plane figures. Look at these figures. They are plane figures because they are flat.

Now look at this figure.



This figure is not a plane figure because a block is not flat. The dotted lines show the back of the block.

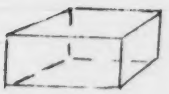
Look at the figures below.

They are not plane figures because they are not flat.

Look at the figures below. Remember, plane figures are flat. Circle the word "plane" if the figure is flat. Circle the words "not plane" if the figure is not flat.

1.

plane not plane

2. 

plane not plane

3.

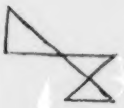
plane not plane

4.

plane not plane

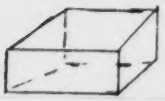
Turn the page to see if you are right.

Here are the answers.

1. 

(plane) not plane

This is a plane figure.

2. 

plane (not plane)

This figure is not plane. The dotted line shows the back of the block.

3.

plane (not plane)

This figure is not plane because it is not flat.

4.

(plane) not plane

This is a plane figure.

Turn the page

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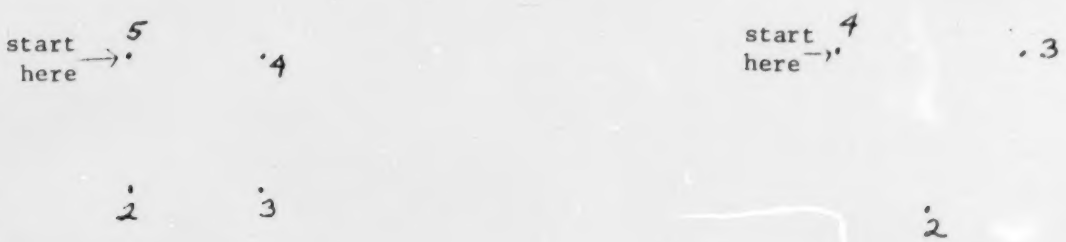
Follow the dots. Is the figure plane?

Yes. It is plane.

Now follow these dots to make two figures. Which figure is plane?



Both figures are plane.

Write "plane" in the blank below.

three straight sides of equal length + three equal angles + _____

You have now learned three important things about equilateral triangles. Say them to yourself.

Turn the page.

Look at the figures below. Trace the figures. Remember, if you come back to where you started, it is a closed figure. Circle the word "closed" if the figure is closed. Circle the words "not closed" if the figure is not closed.

1.

closed not closed

2.

closed not closed

3.

closed not closed

4.

closed not closed

Turn the page to see if you are right.

Here are the answers.

BEST COPY AVAILABLE

1.

closed (not closed)

This figure is not closed. If you trace the figure you would not come back to where you started.

2.

(closed) not closed

This is a closed figure.

3.

closed (not closed)

This figure is not closed. If you trace it you would not come back to where you started.

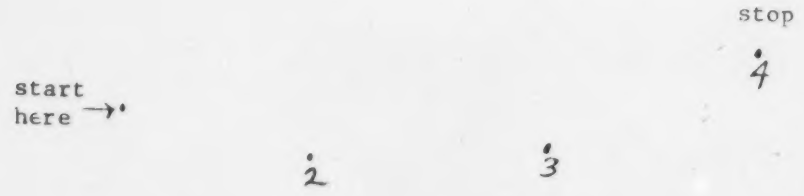
4.

(closed) not closed

This is a closed figure.

Turn the page.

Follow the dots. Be careful. There are only four numbers. Is this a closed figure?



No. It is not a closed figure.

Now follow these dots to make two figures. Are they closed?

Yes. They are closed.

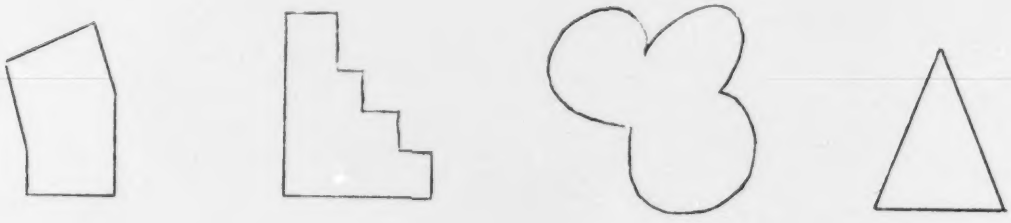
Write "closed" in the blank below.

three straight sides of equal length + three equal angles + plane + _____

You now have learned four important things about equilateral triangles. Say them to yourself.

Turn the page.

Some figures have lines or sides that do not cross. They are called simple figures. For example, look at these figures. They are simple figures.



Connect the dots below.

This figure is simple.

Some figures have lines or sides that do cross. Some figures have lines inside or on the outside. They are not simple figures. Look at the figures below. Can you see why they are not simple figures?

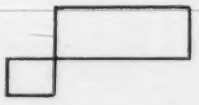
They are not simple figures because their sides cross or they have lines on the inside or outside.

Connect the dots below.

This figure is not simple.
It has a line inside.

Turn the page

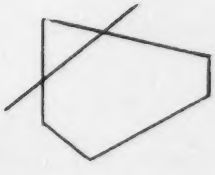
Look at the figures below. Remember, a simple figure does not have sides or lines that cross. If a figure does have lines or sides that cross, it is not simple. Circle the word "simple" if the figure is simple. Circle the words "non simple" if the figure is not simple.

1. 

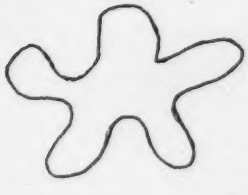
simple not simple

2.

simple not simple

3. 

simple not simple

4. 

simple not simple

Turn the page to see if you are right.

Here are the answers.

1.

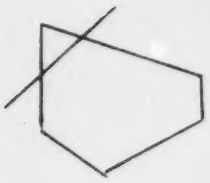
simple (not simple)

This figure is not simple. The arrow shows where the sides cross.

2.

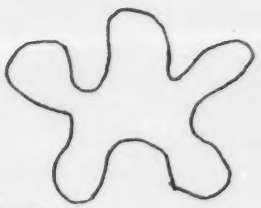
simple (not simple)

This figure is not simple. There is a line inside the figure.

3. 

simple (not simple)

This figure is not simple. The line crosses the sides of the figure.

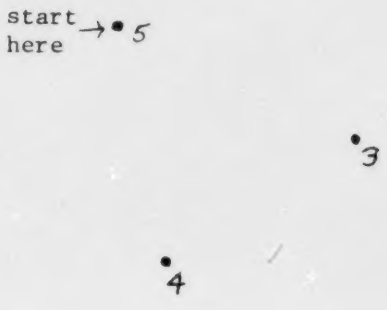
4. 

(simple) not simple

This is a simple figure.

Turn the page

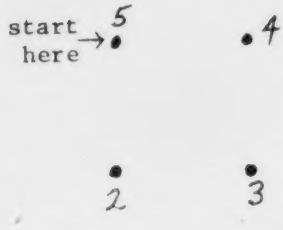
BE CAREFUL! Look at the numbers first. They are mixed up. Now follow the dots in order by number. Is the figure simple?



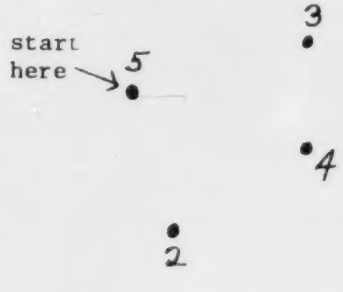
No. It is not a simple figure.

Now look at these numbers. Follow the dots by number. Make two figures.

Which one is simple?



This one is simple.



This one is not simple.

Write "simple" in the blank below.

three straight sides of equal length + three equal angles + plane + closed + _____ = Equilateral Triangle

You have now learned all five important things about equilateral triangles. Say all five things to yourself.

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Directions for Administering Lesson 2E

Good morning (afternoon). I am going to pass out today's lessons now. Some of you will also receive a ruler to help you make some drawings. When you get your booklet, put your name and the name of your school on it. Where it says teacher's name, put only your room number. Leave the rest blank. (Pass out the lesson booklets). I am passing out more than one kind of lesson. It may be that you are reading a different kind of lesson from everyone else. But don't worry about it because this is the way it's supposed to be. Please do not open your booklets until I tell you.

You are going to read this lesson to yourself. While you are reading, there may be some words that you cannot read. If you raise your hand, I will come by and tell you what the words are. Before you raise your hand, try very hard to read the word yourself. Also, if you come to a part where you don't know what you are supposed to do, raise your hand and I will come by.

From now on, there can be no talking to each other or out loud. If you want to ask a question raise your hand. Wait until I come by and then quietly ask your question. Do not disturb your classmates. You may have 25 minutes for this lesson.

Are there any questions before we begin?

No talking please.

Now turn to page 1 and begin your lesson.

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LESSON 2 E

Name _____

Today's Date _____

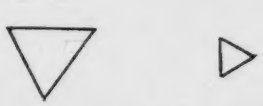
Teacher's Name _____

School's Name _____

Grade _____

Boy Girl

Yesterday you learned some things about figures. You learned that some figures have <u>three straight sides of equal length</u>.



yes

no

You also learned about angles:

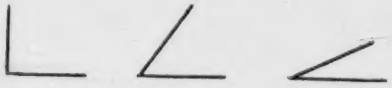
3 angles

2 angles

no angles

Some angles are the same size. They are equal angles.

equal



not equal

You learned that some figures have <u>three equal angles</u>.

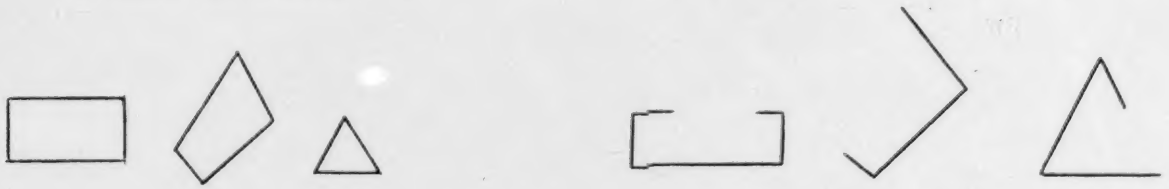
yes

no

You learned that plane figures are flat.

plane not plane

You also learned about closed figures. If you trace them you would come back to where you started.



closed not closed

Remember simple figures? Simple figures do not have lines or sides that cross.

simple not simple

You learned five important things about a special figure. Say the five things to yourself. What is the name of the figure?

three straight sides of equal length + three equal angles + plane + closed + simple = Equilateral Triangle

Equilateral triangle is the name for a special kind of figure. You are now going to learn about equilateral triangles.

Look at these two words: equilateral triangle. You know what a triangle looks like. An equilateral triangle is a special kind of triangle. Equilateral means having all the sides equal.

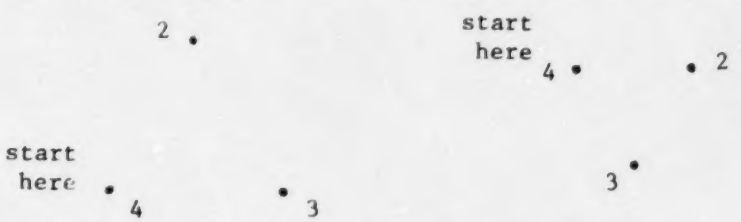
equi means equal

lateral means side

Look at the definition in the box below. It tells you exactly what an equilateral triangle is.

An equilateral triangle has three straight sides of equal length. It has three equal angles. It is a plane, closed and simple figure.

Now let's draw some equilateral triangles. Just connect the dots.



The two figures you have just drawn are all equilateral triangles. They all have three straight sides of equal length. They all have three equal angles. All of them are plane, closed and simple figures. An equilateral triangle can be large or small. It does not matter how it is turned.

Look at the equilateral triangle below. See if you can make one exactly like it.

Turn the page.

Read the definition again.

> An equilateral triangle has three straight sides of equal length. It has three equal angles. It is a plane, closed and simple figure.

Look carefully at these figures.

1.

Figure 1 is an equilateral triangle. It has three straight sides of equal length. It has three equal angles. It is a plane, closed and simple figure.

2.

Figure 2 is not an equilateral triangle because it is a complex figure.

3.

Figure 3 is not an equilateral triangle because it is a solid figure. Equilateral triangles are flat.

4.

Figure 4 is an equilateral triangle. It has three straight sides of equal length. It has three equal angles. It is a plane, closed and simple figure.

Turn the page.

Remember the definition.

> An equilateral triangle has three straight sides of equal length. It has three equal angles. It is a plane, closed and simple figure.

Look carefully at these figures.

5.

Figure 5 is <u>not</u> an equilateral triangle because it is open.

6.

Figure 6 <u>is</u> an equilateral triangle. It has three straight sides of equal length. It has three equal angles. It is a plane, closed and simple figure.

Now look carefully at these figures.

7.

Figure 7 <u>is</u> an equilateral triangle.

8.

Figure 8 is <u>not</u> an equilateral triangle because it is a solid figure. Equilateral triangles are flat.

Turn the page.

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Remember the definition.

> An equilateral triangle has three straight sides of equal length. It has three equal angles. It is a plane, closed and simple figure.

Now look at these figures.

9.

Figure 9 is <u>not</u> an equilateral triangle. Its sides and angles are not equal. Equilateral triangles have three equal sides and three equal angles.

10.

Figure 10 <u>is</u> an equilateral triangle.

11.

Figure 11 is <u>not</u> an equilateral triangle because it does not have three straight sides.

12.

Figure 12 <u>is</u> an equilateral triangle.

Turn the page.

Look at the figure below.

How do we know that it is an equilateral triangle? The way we know is by answering these five questions. Look at the answers.

1. Does it have three straight sides of equal length?	(YES)	NO
2. Does it have three equal angles?	(YES)	NO
3. Is it a plane figure?	(YES)	NO
4. Is it a closed figure?	(YES)	NO
5. Is it a simple figure?	(YES)	NO

You can see that YES was circled each time. Because you can answer YES to all five questions, the figure is an equilateral triangle.

You will now see some more figures. Some will be equilateral triangles. Some will not. Your job will be to tell if the figure is an equilateral triangle. Each time you see a figure, ask yourself these five questions.

1. Does it have three straight sides of equal length?
2. Does it have three equal angles?
3. Is it a plane figure?
4. Is it a closed figure?
5. Is it a simple figure?

If you answer YES to all five questions, it is an equilateral triangle. If you answer NO to any of the five questions, it is not.

Now turn the page.

Remember, your job is to tell if the figure is an equilateral triangle. Be sure to circle YES or NO to each of the five questions. Then circle YES or NO after the question: Is it an equilateral triangle?

1. Does it have three straight sides of equal length? YES NO
2. Does it have three equal angles? YES NO
3. Is it a plane figure? YES NO
4. Is it a closed figure? YES NO
5. Is it a simple figure? YES NO

Is it an equilateral triangle? YES NO

1. Does it have three straight sides of equal length? YES NO
2. Does it have three equal angles? YES NO
3. Is it a plane figure? YES NO
4. Is it a closed figure? YES NO
5. Is it a simple figure? YES NO

Is it an equilateral triangle? YES NO

Now turn the page to see if you are right.

Here are the answers.

If you do not remember your answer, turn back to page 8.

1. Does it have three straight sides of equal length? (YES) NO
2. Does it have three equal angles? (YES) NO
3. Is it a plane figure? (YES) NO
4. Is it a closed figure? (YES) NO
5. Is it a simple figure? YES (NO)

Is it an equilateral triangle? YES (NO)

1. Does it have three straight sides of equal length? (YES) NO
2. Does it have three equal angles? (YES) NO
3. Is it a plane figure? (YES) NO
4. Is it a closed figure? (YES) NO
5. Is it a simple figure? (YES) NO

Is it an equilateral triangle? (YES) NO

Turn the page.

Remember, answer YES or NO to each question. You write YES or NO this time. Then you will know if the figure is an equilateral triangle.

1. Does it have three straight sides of equal length?
2. Does it have three equal angles?
3. Is it a plane figure?
4. Is it a closed figure?
5. Is it a simple figure?

Is it an equilateral triangle?

1. Does it have three straight sides of equal length?
2. Does it have three equal angles?
3. Is it a plane figure?
4. Is it a closed figure?
5. Is it a simple figure?

Is it an equilateral triangle?

Turn the page to see if you are right.

Here are the answers.

If you do not remember your answers, turn back to page 10.

1. Does it have three straight sides of equal length? NO
2. Does it have three equal angles? YES
3. Is it a plane figure? YES
4. Is it a closed figure? NO
5. Is it a simple figure? YES

Is it an equilateral triangle? NO

1. Does it have three straight sides of equal length? NO
2. Does it have three equal angles? NO
3. Is it a plane figure? YES
4. Is it a closed figure? YES
5. Is it a simple figure? YES

Is it an equilateral triangle? NO

Turn the page.

Remember, if you answer YES to all five questions, the figure is an equilateral triangle. If you answer NO to any of the five questions, it is not. Be sure to write YES or NO.

1. Three straight sides of equal length?
2. Three equal angles?
3. Plane figure?
4. Closed figure?
5. Simple figure?

Is it an equilateral triangle?

1. Three straight sides of equal length?
2. Three equal angles?
3. Plane figure?
4. Closed figure?
5. Simple figure?

Is it an equilateral triangle? YES NO

Turn the page. See if you are right.

Here are the answers.

Turn back to page 12 if you do not remember your answers.

1. Three straight sides of equal length? YES
2. Three equal angles? YES
3. Plane figure? YES
4. Closed figure? YES
5. Simple figure? YES

Is it an equilateral triangle? YES

1. Three straight sides of equal length? NO
2. Three equal angles? NO
3. Plane figure? YES
4. Closed figure? YES
5. Simple figure? YES

Is it an equilateral triangle? NO

Turn the page.

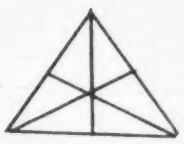
How do we know if a figure is an equilateral triangle?

Ask yourself these five questions.

1. Does it have three straight sides of equal length?
2. Does it have three equal angles?
3. Is it a plane figure?
4. Is it a closed figure?
5. Is it a simple figure?

Let's look at some more figures. Write YES if the figure is an equilateral triangle. Write NO if the figure is not. REMEMBER, ask yourself all five questions.

Is this figure an equilateral triangle?



Is this figure an equilateral triangle?

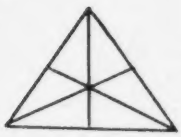
Turn the page to see if you are right.

Here are the answers.

If you do not remember your answers, turn back to page 14.

1. Three straight sides of equal length? YES
2. Three equal angles? YES
3. Plane figure? YES
4. Closed figure? YES
5. Simple figure? YES

Is it an equilateral triangle? YES

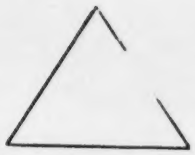


1. Three straight sides of equal length? YES
2. Three equal angles? YES
3. Plane figure? YES
4. Closed figure? YES
5. Simple figure? NO

Is it an equilateral triangle? NO

Turn the page.

Answer YES or NO.



Is this an equilateral triangle?

Is this an equilateral triangle?

Is this an equilateral triangle?

Turn the page to see if you are right.

Here are the answers.

If you do not remember your answers, turn back to page 16.

1. Three straight sides of equal length? NO
2. Three equal angles? YES
3. Plane figure? YES
4. Closed figure? NO
5. Simple figure? YES

Is it an equilateral triangle? NO

1. Three straight sides of equal length? NO
2. Three equal angles? NO
3. Plane figure? YES
4. Closed figure? YES
5. Simple figure? YES

Is it an equilateral triangle? NO

1. Three straight sides of equal length? YES
2. Three equal angles? YES
3. Plane figure? YES
4. Closed figure? YES
5. Simple figure? YES

Is it an equilateral triangle? YES

Turn the page.

Answer YES or NO.

Is this an equilateral triangle?

Turn the page to see if you are right.

Here is the answer.

If you do not remember your answers, turn back to page 18.

1.	Three straight sides of equal length?	NO
2.	Three equal angles?	NO
3.	Plane figure?	YES
4.	Closed figure?	YES
5.	Simple figure?	YES

Is this an equilateral triangle? NO

When you finish, go back over your work.

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